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ABSTRACT

This teacher's guide is for an environmental education module to integrate topics of water quality in ninth- and tenth-grade social studies classes. This module was pilot tested in Gwinnett County, Georgia in 1975-76. Included in the guide are overall objectives, the module sequence, an introduction, a suggested teaching sequence, a word review game, and review and reading exercises. The module sequence is divided into four parts. The first part provides an introductory episode to stimulate student interest in an environmental issue concerning water. The second part is designed to improve understanding of water resources and treatment. The third part develops social studies concepts around examples from the county community. In the fourth part, the student applies what he/she has learned to prepare a publicity project. This module is intended to go with a similar one in ninth- and tenth-grade chemistry classes. (BB)

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TEACHER'S GUIDE

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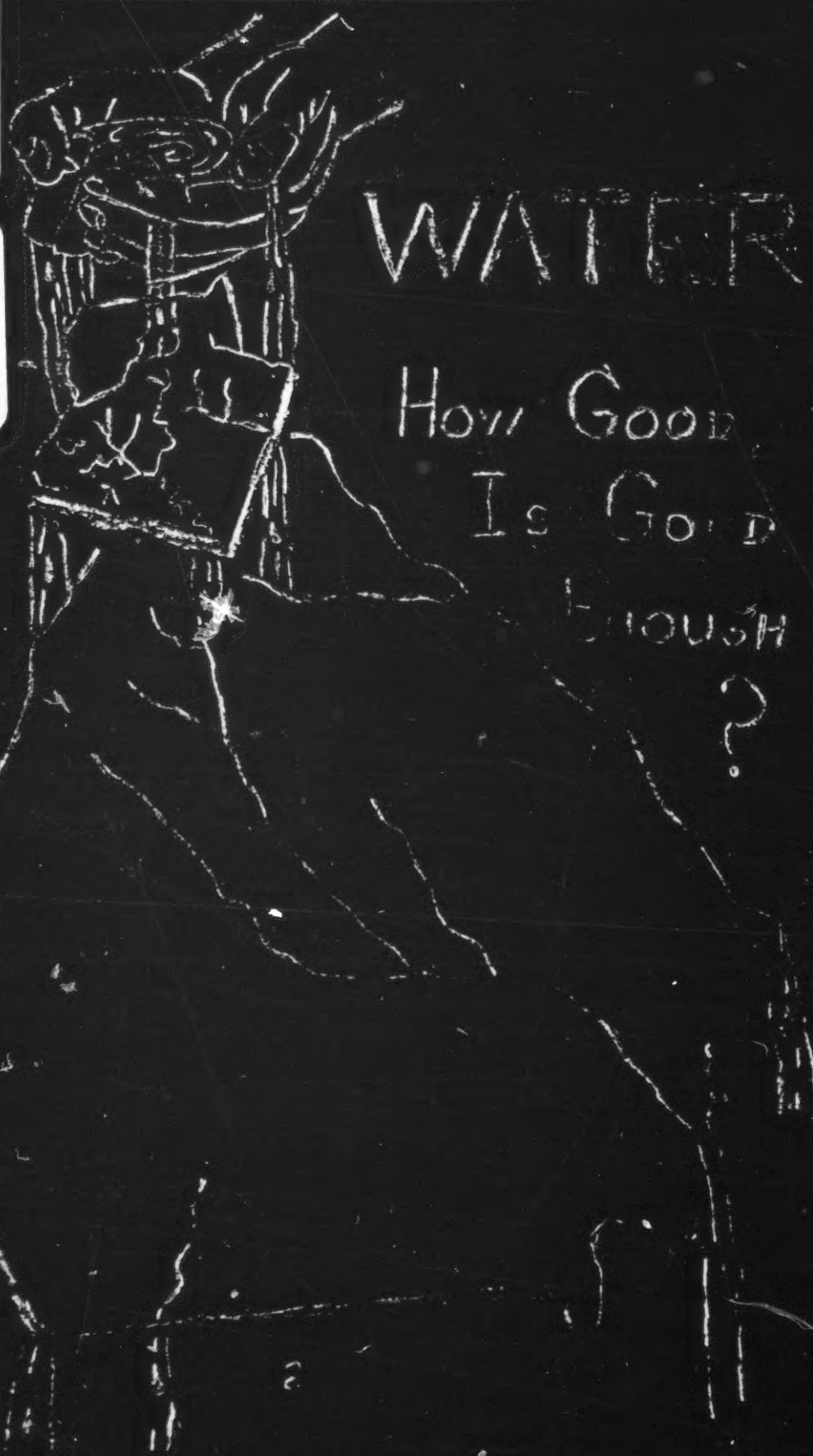

TEACHER'S GUIDE

for

WATER: HOW GOOD IS GOOD ENOUGH?

Social Studies Module

(9th-10th grade Social Studies)

Pilot Tested in Gwinnett County, Georgia, 1975-1976

Developed by ENVIRONMENTAL EDUCATION FOR THE SECONDARY SCHOOLS, a curriculum project of the College of Education of the University of Georgia, Dr. Mary A. Hepburn, Director. This project (Project No. 522AH51215) was supported by the U. S. Office of Education under the Environmental Education Act. All rights reserved.

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Environmental Education for the Secondary Schools is a curriculum project which developed these instructional materials to help high school students respond intelligently to environmental policy issues. Utilizing local issues to stimulate interdisciplinary thinking and environmental problem solving, the modular materials are coordinated for social studies and natural science classes.

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Environmental Education for the Secondary Schools, 1975-1976

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CONTENTS

Overall Objectives

Modules Sequence

Introduction

Suggested Teaching Sequence

Word Review Game

Review and Reading Exercises

Environmental Education for The Secondary Schools

Overall Objectives

Cognitive

Students will be able to:

- -- define conditions of their environment in terms of interrelationships of the biotic and abiotic components
- -- gather, organize and relate environmental data from science and social studies
- -- relate first hand field investigation and experimentation to more abstract environmental knowledge
- -- specifically delineate sources of population problems, water problems, land use problems and waste disposal problems in the county community
- -- focus on public issues in selecting areas for scientific - environmental experimentation
- -- utilize science knowledge in making social decisions
- -- identify, examine and evaluate consequences of alternative public responses to given environmental problems and the potential trade-offs involved
- -- determine channels for citizen action on specific issues and compare them
- -- relate detailed knowledge of local environmental problems to environmental problems of the state and region

Affective

Students will:

- -- demonstrate involvement in local environmental issues
- -- demonstrate a commitment to using the knowledge and skills of science and social studies in analyzing environmental problems and determining action
- -- express interest in other related problems of the state and national environment
- -- demonstrate a rational, evaluative attitude toward making environmental choices

MODULES SEQUENCE

1. OPENING
   Immersion in Environmental Problems by Means of

   -- Dramatic Episode (Factual or Fictional Based on Fact)
   -- Perplexing Situation - News Reporting Style
   -- Visual series or a Visuals/Quotations Montage

2. INFORMATIONAL STAGE
   Build Foundations for Decision-Making by providing

   -- Data and Perspectives for building to summary statements or generalizations
   -- Summary statements for analysis and application to other sets of data
   -- Values "Situations"

3. UTILIZATION - OPPORTUNITY TO APPLY PREVIOUS LEARNING TO A PARTICULAR PROBLEM STUDIED IN MORE DEPTH

   -- Case Study or Detailed Report
   -- Comparative Study
   -- Multiple Perspectives

4. ACTION - EXPLORATION OF CHANNELS FOR INDIVIDUAL AND GROUP ACTION

   -- Individual Action
   -- Obtaining Information, Familiarity with Agencies of Research, Information and Service
   -- Interest Groups or Pressure Groups
   -- Publicity - Keeping Others Informed
   -- Civic Action - Using formal Political Channels to provide a public forum on the issue to bring about change and improvement

5. EVALUATION

   -- Evaluate learning outcomes
   -- Internal evaluation of modular instructional unit
   -- Estimate apparent community effects

Introduction

Part I

"What's the Problem"provides an introductory episode to stimulate student interest in an environmental issue concerning water. The taped dialogue presents a situation which should provoke student thinking about flooding, proper land use and proper care of water resources.

Part II

"Water: Where Does It Come From and Where Does It Go?" is designed to improve understanding of water sources and treatment. This section attempts to build science knowledge which can be related to the social studies concepts to be dealt with in Part III.

Part III

"The People: Who Decides and Who Is Responsible?" develops social studies concepts around examples from the county community. In this application section the student should be able to apply what he has learned to several local issues which concern water supply and treatment.

Part IV

"The Individual: What Can You Do?" is the action stage of the module sequence. Here the student applies the science and social studies learned in previous lessons in reviews and synthesis to prepare a publicity project.

SUGGESTED TEACHING SEQUENCE

Part I What's The Problem?

Day 1 - Objectives

Students should be able to:

1) identify the problem in the fictional dialogue (flooding).
2) answer inferential questions after listening to an audio tape.
3) find answers to informational questions about the reading.
4) define key words.
5) hypothesize about the sources of the problems presented in Gwinnett Scene.

Teaching Procedures

1. Play the cassette tape, "Break For Blue Sunshine," discuss for clear meaning.
2. Discuss multiple choice questions for a review of the C.B. tape.
3. Go over word list in review test and clarify those which students do not know.
4. Read Fish Tale dialogue, discuss what it is about (encourage inferential reasoning, p. 8).
5. Students read summary, "What's It All About" (p. 6-7) and discuss this to pinpoint the problem locally.
6. (Optional) Students may enjoy reading and analyzing the shifting ideas of "What Wood You Do?"(copymaster on next page).

Part III Where Does It Come From?

Day 2 - Objectives

Students should be able to:

1) define ground water and surface water.
2) identify and distinguish between examples of ground water and surface water.
3) list at least 3 methods of obtaining water.
4) use information from the chart, activity and reading to explain the water table in writing.
5) explain the abbreviation MGD.

Teaching Procedures

1. Read p. 10-11 to consider the sources of ground water and discuss p. 12.
2. Underground water flow chart is provided for transparency or ditto master (next page). Go over this orally with students.
3. Read and discuss p. 13-14 concerning surface water.

(Copy Master)

What Wood You Do?

Rusty: "I cut down my pine trees on half of my property."

Billy: "That's bad!"

R: "No, that's good."

B: "Why do you say that?"

R: "I sold them for pulp wood."

B: "That's good."

R: "No, that's bad."

B: "Why do you say that?"

R: "The rain is washing my topsoil down into the stream."

B: "That's bad."

R: "No, that's good."

B: "Why do you say that?"

R: "The rain will help the grass seed sprout that I planted."

B: "That's good."

R: "No, that's bad."

B: "Why do you say that?"

R: "Now, my family wants me to spend the pulpwood money to buy some ponies and some cows and some goats and some chickens and some pigs."

B: "That's bad."

R: "No, that's good."

B: "Why do you say that?"

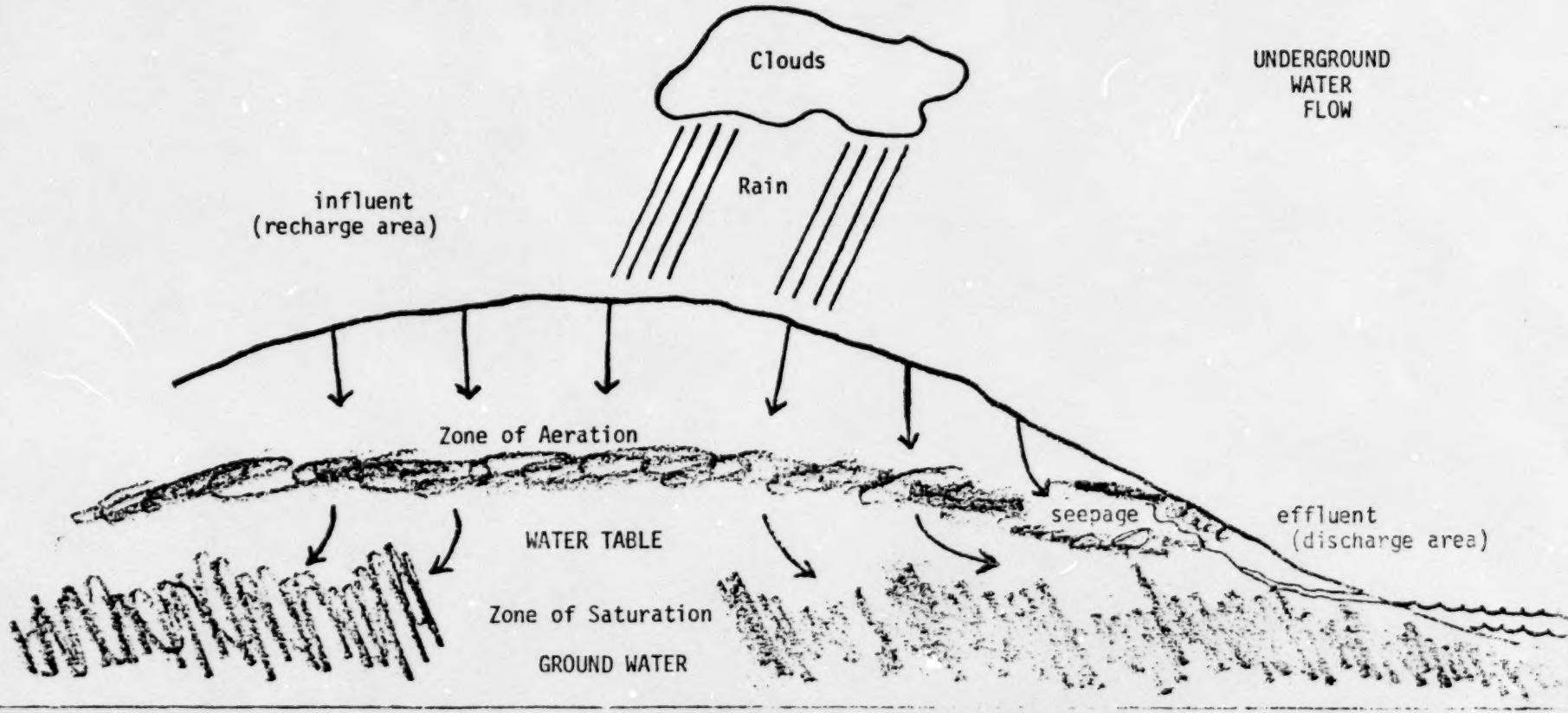
R: "Now we can raise our own food."

B: "That's good."

R: "No, that's bad."

B: "Why do you say that?"

R: "That many animals will overgraze that small pasture and cause erosion."


Clouds
Rain
UNDERGROUND
WATER
FLOW
influent
(recharge area)
Zone of Aeration
seepage
effluent
(discharge area)
WATER TABLE
Zone of Saturation
GROUND WATER

(COPY MASTER)

Day 3 - Objectives

Students should be able to:

1) locate the water treatment plants on a county map.
2) locate and mark the Chattahoochee and Yellow Rivers on the map.
3) demonstrate how a key explains symbols on the map.
4) indicate the watershed area of the Yellow River on the exercise map.
5) identify and locate surface water sources near the school community.
6) explain the effects of the continental divide on water sources in the local area.

Teaching Procedures

1. Follow the class activity on p. 15, "Mapping Surface Water Sources" (copymaster for transparency or individual copies is provided on the next page.).
2. Read and discuss "the continental divide" on p. 17.
3. A large topographic map of the metro area including Gwinnett would enhance this class activity.

Days 4 - and 5 - Objectives

Students should be able to:

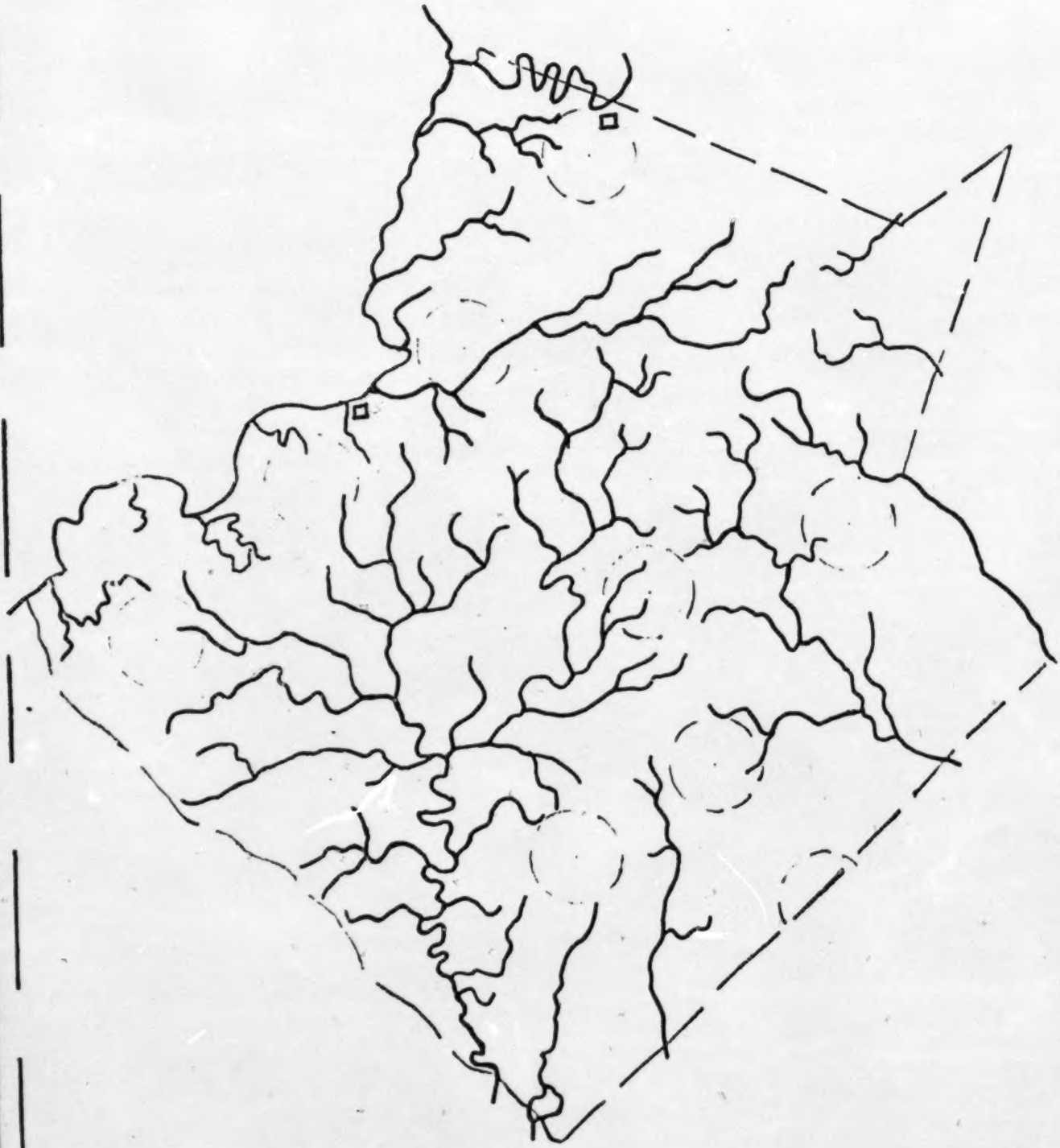
1) find answers to informational questions about the material in the newspaper articles.
2) hypothesize about the causes of the problem presented in the Gwinnett Scene.
3) list the ways we use water in our daily lives.
4) distinguish between essential and non-essential factors in our lives.

Teaching Procedures

1. Read article on Dacula Water system p. 18 and go over questions (note costs.) This and the following article could be assigned to two groups.
2. Read Sugar Hill article p. 19. Compare that water system with the one described by Anna Barber (p. 20). Both articles could be compared with the Gwinnett Scene.
3. Use multiple choice questions on p. 21 for review.
4. Read page 22.
5. Activity on choice-making p. 23 (Note how values affect the way options are narrowed.).

(Transparency)

GWINNETT COUNTY WATERSHEDS



Part II How Do We Test and Maintain the Quality of Our Water?

Day 6 - Objectives

Students should be able to:

1) distinguish between examples of private and public water systems.
2) explain the processes of sedimentation, filtration and chlorination.
3) complete a chart showing the stages of water treatment process.
4) determine the percentage of people in Gwinnett County on public water systems.
5) identify several government agencies which provide for water supply service.

Teaching Procedures

1. Read pp. 24-27 concerning wells and water treatment plants.
2. Explain diagram on p. 27. Water purification process chart is provided for transparency or ditto master (next page).

Day 7 - Objectives

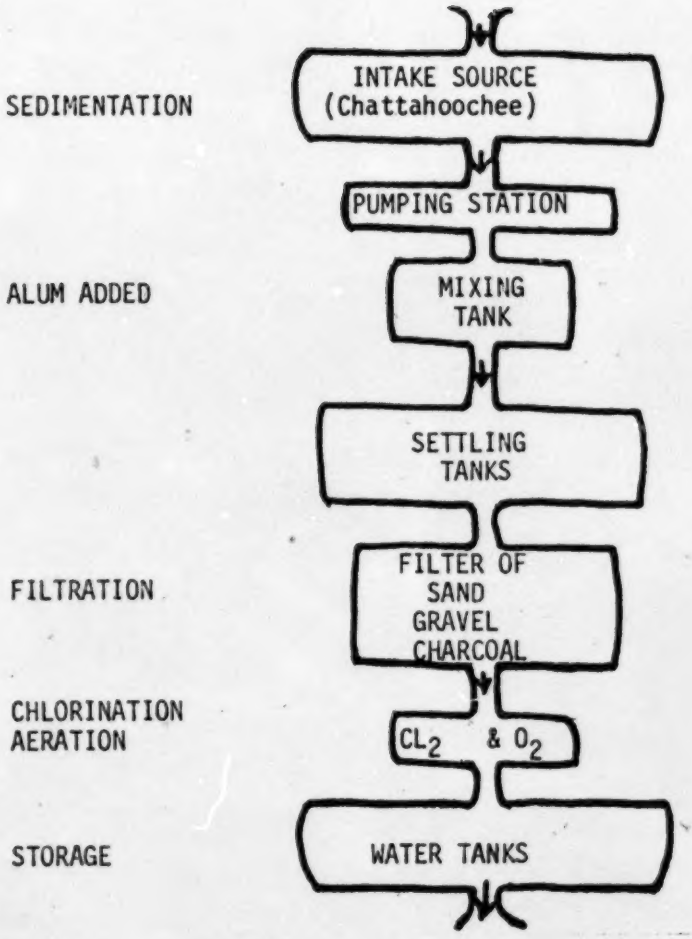
Students should be able to:

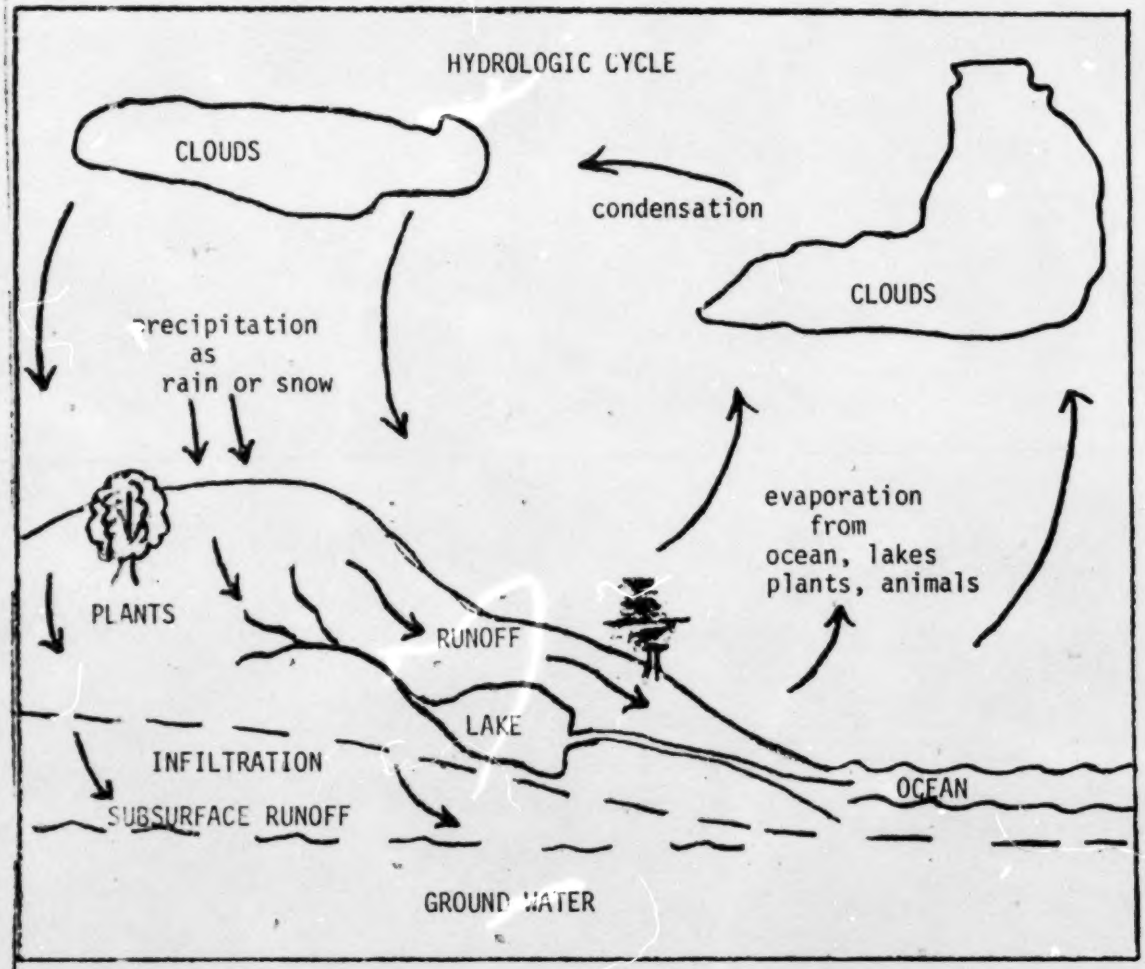
1) recognize that the hydrologic cycle is a closed process from the reading and teacher questions.
2) trace the direction of the hydrologic cycle by listing the stages in proper sequence.
3) explain the hydrologic cycle.

Teaching Procedures

1. Introduce reading with questions about where water goes and how it returns.
2. Questions on p. 30 for class discussion (#4 is inferential in nature).
3. Diagram of the hydrologic cycle is provided for transparency or ditto master. Have students list the cycle stages.

WATER PURIFICATION PROCESS




HYDROLOGIC CYCLE
CLOUDS
condensation
CLOUDS
precipitation
as
rain or snow
evaporation
from
ocean, lakes
plants, animals
PLANTS
RUNOFF
LAKE
INFILTRATION
OCEAN
SUBSURFACE RUNOFF
GROUND WATER

Part II What Happens To Water After We Have 'Used' It?

Days 8 and 9 - Objectives

Students should be able to:

1) answer informational questions about the Gwinnett Scene.
2) hypothesize about the causes and solutions to the problem presented in the Gwinnett Scene.
3) define key words in vocabulary list.
4) state advantages for having a county soil survey.
5) summarize the main ideas in county ordinances dealing with flooding and erosion.
6) apply the "Water Usage Table" to analyzing personal home water usage.

Teaching Procedures

1. Discuss in class the preview questions (p. 31) as a vocabulary lesson. (Note: All the answers are A, and #4 should read "A septic tank is designed to handle.")
2. Read Gwinnett Scene "Bubble" (p. 32).
3. After doing the review questions (p. 33) have students discuss their reasons for their answers to #4-7.
4. Read pp. 34-37 concerning planning and county ordinances.
5. Select two students to read the dialogue "A Community Problem" (p. 38).
6. Use questions on p. 39 to introduce chart interpretations. Have students make other interpretations. Assign "Follow-up Investigation" to class or groups of students as outside work.

Day 10 - Objectives

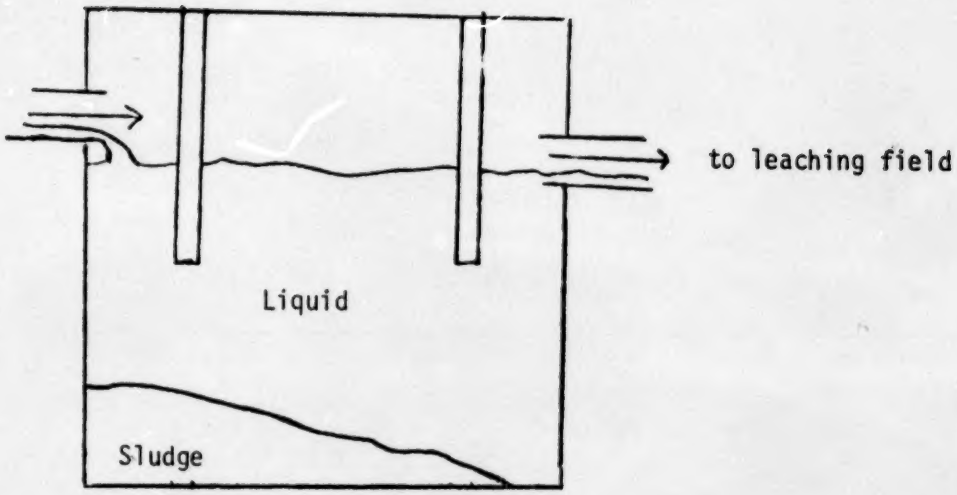
Students should be able to:

1) list and categorize the numerous ways we "use" water.
2) identify the septic tank as a private sewage treatment facility.
3) define B.O.D., effluent, aerobic and anaerobic.
4) explain the reoxygenation process in a swift-moving stream.

Teaching Procedures

1. Ask students to review major ways that water supply is "used up."
2. Read pages 40-44 concerning used water and septic tanks.
3. A side view diagram of a septic tank is provided for transparency or ditto master to compliment the diagrams on page 43.
4. Ask students to comment on the meaning of statement on p. 42 " . . . outhouses are out."

Side View of Septic Tank



Day 11 - Objectives

Students should be able to:

1) distinguish between public and private sewage treatment systems.
2) complete an outline of the waste water treatment process.
3) list methods for cleaning residential waste water.
4) trace the flow of waste water through a sewerage system.
5) analyze the content of newspaper articles.
6) define key vocabulary words.

Teaching Procedures

1. Read pages 45-50 containing three newspaper articles, a diagram of a sewerage system, a map locating sewage treatment plants, a chart of the waste water treatment process and a list of review words for Part II.
2. Charts of a sewerage system and the waste water treatment process are provided for transparency or ditto master on next 2 pages. Discuss these charts with class.

Day 12 - Objectives

Students should be able to:

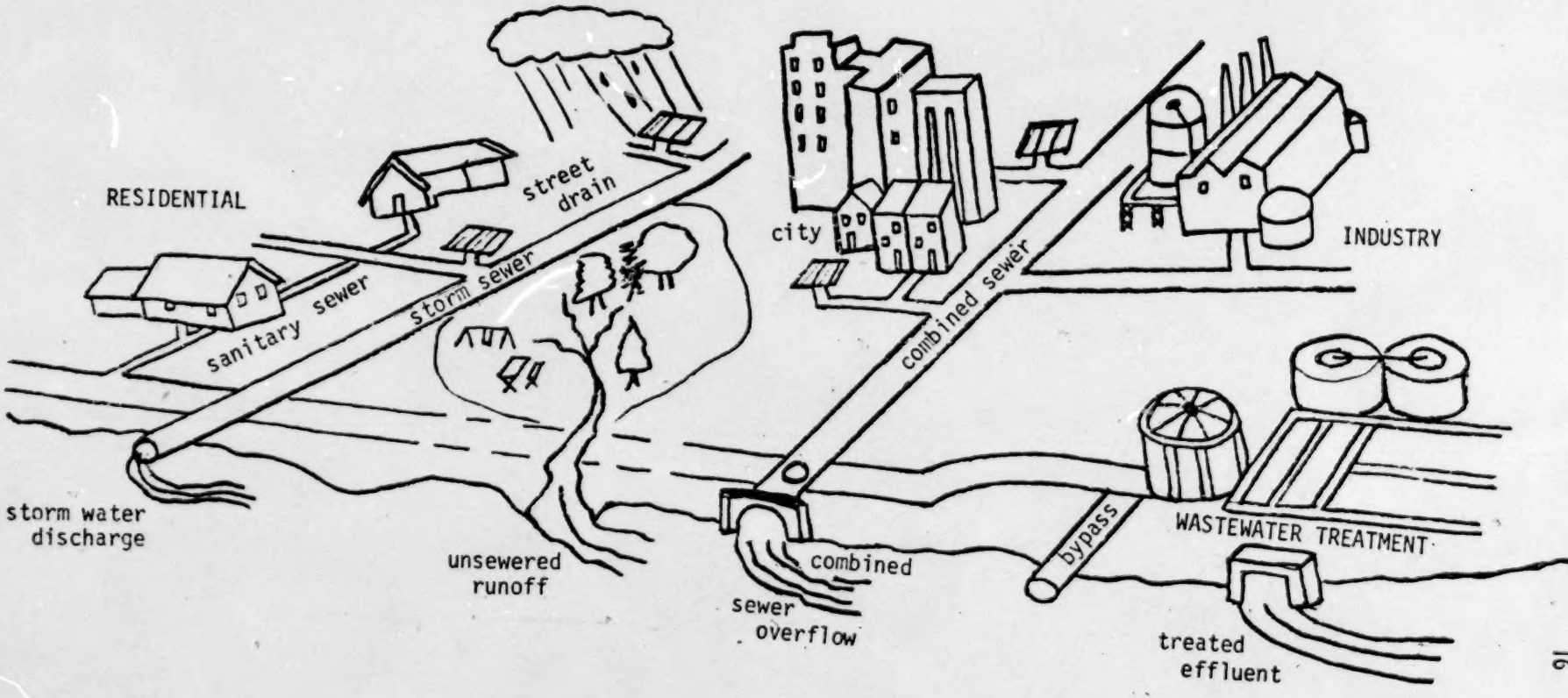
1) synthesize information from classes with that offered by the guest speaker by asking questions or by writing a summary of the talk.
2) demonstrate their understanding of water sources, uses, treatment or supply by carrying out a communications project.

Teaching Procedures

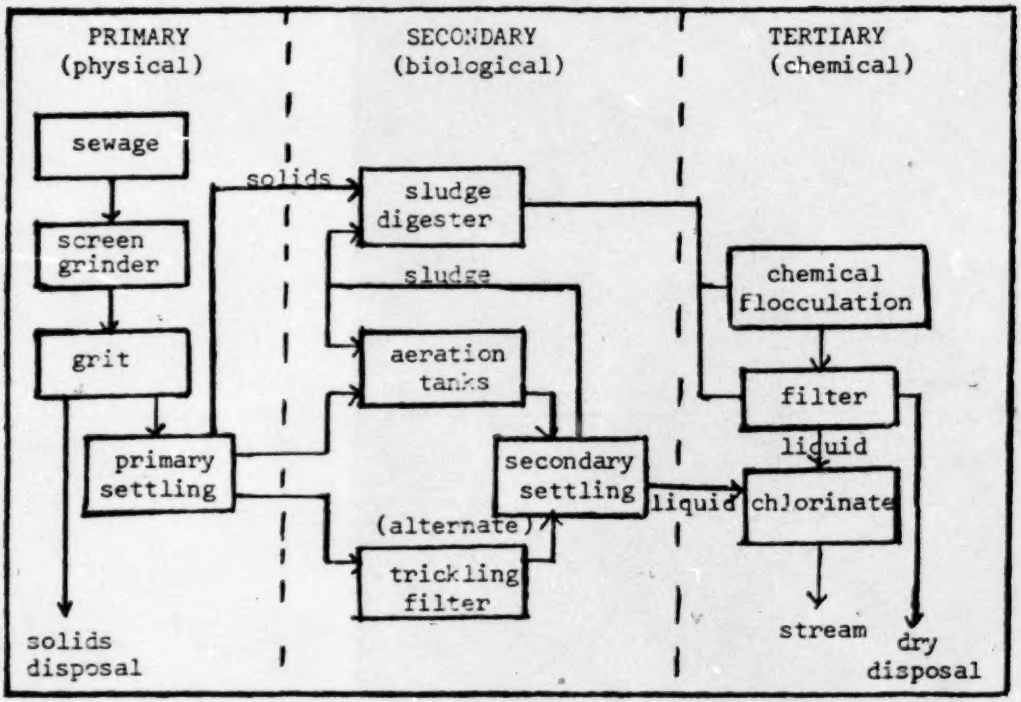
1. Introduce guest speaker whose work is related to water processing,(John Bryson, a Gwinnett County Extension Agent, gives an excellent talk on the "Essence of Crud") dealing with septic tanks, ground water and water table. The guest speaker day should be planned several weeks in advance. Fit this in according to the specific topic to be covered and the local arrangements you have made. (Consider officials from the water departments or water plants.)
2. In the last ten minutes introduce the final project assignment using ideas on pages 68-69. Emphasize the purpose of the project: To communicate what they know about some aspect of water sources, uses, treatment and supply systems to other people in the school or larger county community.

   (Note: The guest speaker is an example of a Gwinnett citizen communicating what he knows about sewage treatment to enlighten others. Students likewise can communicate their knowledge of water processes to others.

SEWERAGE SYSTEM



THE PROCESS AT A WASTE WATER TREATMENT PLANT



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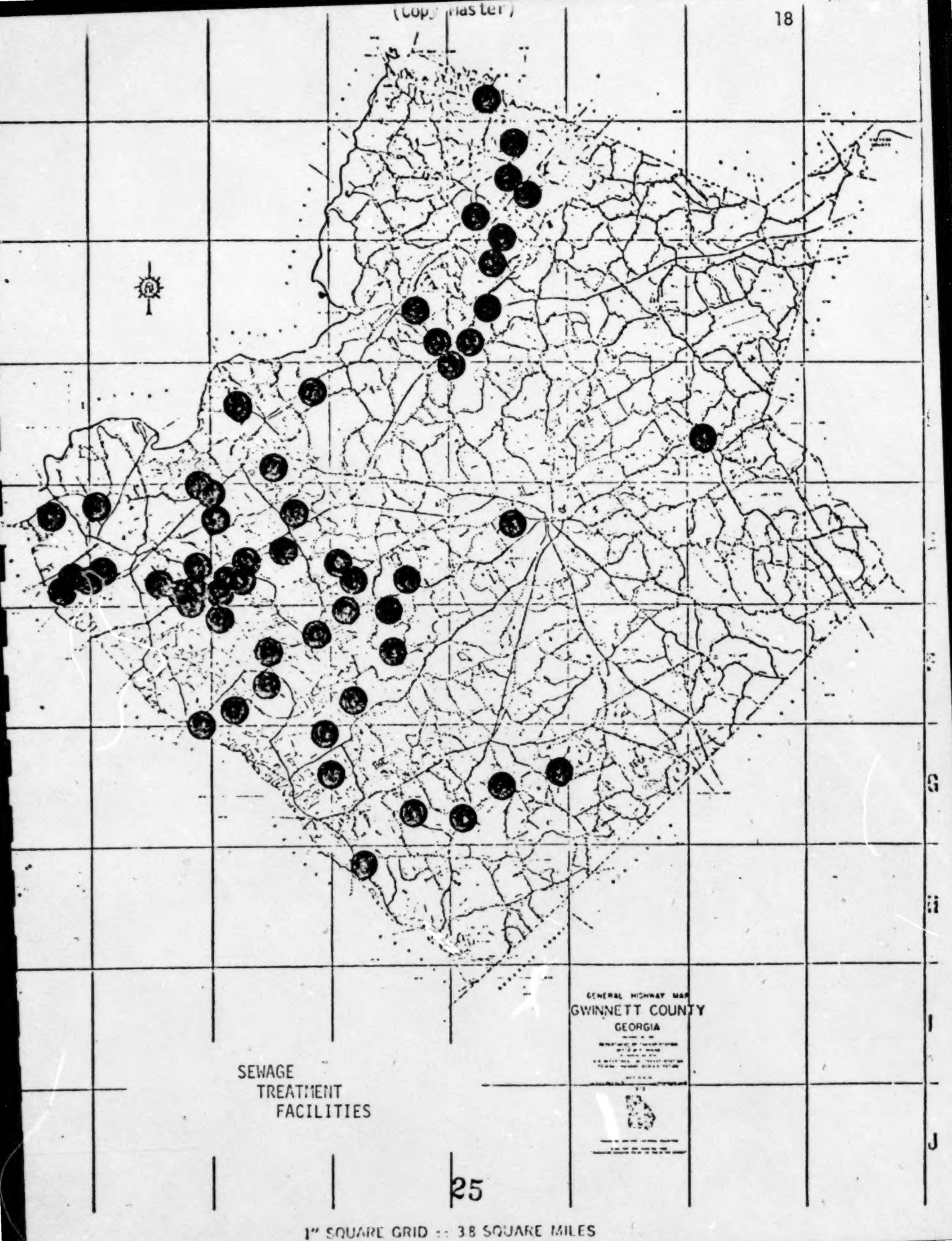

GENERAL HIGHWAY MAP
GWINNETT COUNTY
GEORGIA
SEWAGE
TREATMENT
FACILITIES
25
1" SQUARE GRID = 38 SQUARE MILES

Part III The People: Who Decides and Who is Responsible?

Day 13 - Objectives

Students should be able to:

1) define ecology, conservation and environment.
2) distinguish between the concepts of quality and quantity by recognizing examples of each.
3) interpret quotations about the environment and analyze implications.
4) write a statement of closure for a given dialogue.

Teaching Procedures

1. Using the sketches on page 51, ask students to list which people Part III is talking about.
2. Read aloud and discuss the quotations on page 52 and related text on page 53.
3. Read class activity, "What Is Wasted?" (p. 54) and discuss answers to the questions in class.
4. Read dialogue "Who Decides" (p. 55). Organize students into small groups to continue the dialogue. Then compare the different ways that the groups close the dialogue.
5. Supply students with examples of the concepts of quality and quantity as they relate to water.

Day 14 - Objectives

Students should be able to:

1) identify the several levels of government concerned with water.
2) list advisory agencies that deal with water problems.
3) give examples of the interrelated regulation of water by several government agencies.
4) explain interdependence and give examples of the concept in regard to water supply and usage.
5) define key vocabulary from the reading.

Teaching Procedures

1. Ask students why water must be protected and use discussion to lead into reading pp. 57-59.
2. Introduce the terms "interdependence" and "independence" in preparing students to read pp. 60-61.
3. Follow with class activity "Who Depends on Whom for What?" p. 62. Stress examples of the two terms.
4. Assign review of "Words You Should Know".

Day 15 - Objectives

Students should be able to:

1) distinguish, circle, and define the environmental words in a maze of letters.
2) apply understandings about water supply and treatment to preparing a written accompaniment to a situation drawing.
3) relate visual scenes (in slides) to concepts previously studied.
4) identify examples from slides showing the interrelationships among the many factors in the total environment.

Teaching Procedures

1. Assign "Hidden Words" activity (p. 64). This review used as an outside project or contest will test which student can find the most words. It promotes word recognition for this unit of study. (Copy master is included on next page).
2. Encourage students to think creatively about the situation in the drawing on p. 65, and write their response.
3. Lead the class activity "Putting It Together" on p. 66 (slides are provided) to review examples of:

    a) erosion, flooding, siltation
    b) urban runoff
    c) parts of a public water system
    d) evidence of nutrients from septic tank water
    e) wells and outhouses

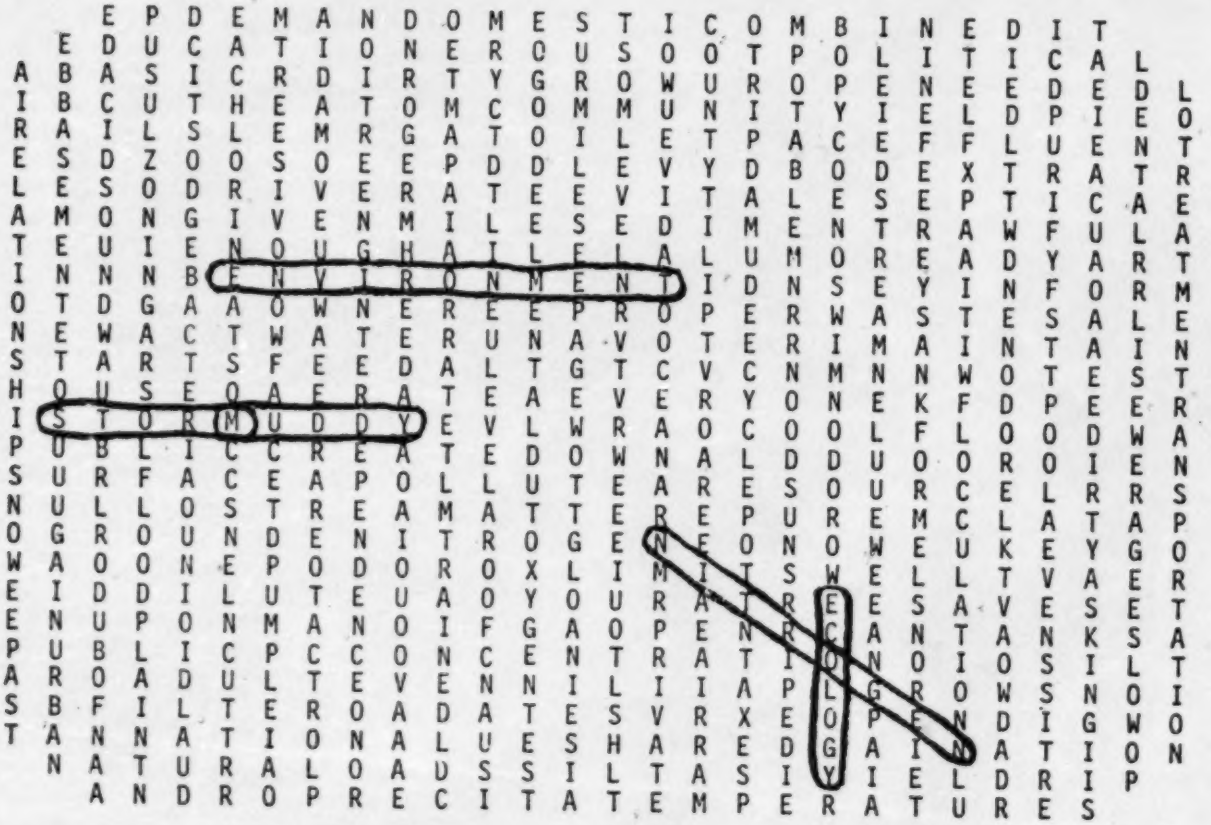
4. Use the set of slides of the physical layout of the processes at the Jackson Waste Water Treatment Plant to preview a field trip to a Gwinnett County treatment plant to take place on the next day. (Be sure to call the Department of Water Quality Control to make the appointment for the field trip at least two weeks in advance.)

Day 16 - Objectives

Students should be able to:

1) describe the waste water treatment process at the plant.
2) compare the quality of the water coming into and leaving the plant.
3) report how much of the county's sewerage system comes to this plant.
4) identify the sources of sewage coming into the plant.
5) explain what happens to the treated water after it leaves the plant.
6) relate what they have learned in class to what they see at the plant. The students assume the role of news reporter and ask questions of the guide.

HIDDEN WORDS



Review What You Have Learned

A. Find the words that are related to your studies about water and the environment. Circle the letters that form the words. Each letter can possibly be used to form some kind of word. Some letters can be used in more than one word.

B. After you circle the word, write it down and define as many as you can.

WHAT DO YOU THINK?

Write your own story

or cartoon lines
or article
or anything

(Copy Master)

Teaching Procedures

1. Encourage students to ask questions during the field trip.
2. Have students find out why there are so many tomato plants around the sewage treatment plant (in the spring of the year).

Day 17 - Objectives

Students should be able to:

1) summarize the major problems dealing with supply and treatment of water in a review discussion drawing from the textbook and field trip.
2) demonstrate their understanding of a selected concept of water supply or treatment by completing a "publicity project" which communicates information or advice to others.
3) Utilize information learned from class and field trip to conduct an interview or write a news story assuming the role of a reporter.

Teaching Procedures

1. A follow-up activity should highlight the information gained during the field trip (see p. 67). Two ideas are:
    a) have students write a news article or a personal observation about some aspect of the field trip.
    b) have students stage interviews with other classmates, one acting as a reporter (e.g. Walter Cronkite) using tape recorders. Questions raised or answered during the field trip should be covered.
2. Go over pp. 68-69 with students regarding the publicity project, "Getting Down To Action." Encourage students to relate their projects to the local community. Also encourage them to show the relationship of water problems to other problems of the environment. Note: Some possibilities for projects are:
    a) draw up a newspaper ad.
    b) design a billboard, bumper sticker, poster, collage, pamphlet, or jacket for an environmental book.
    c) collect slogans and commercials used on television related to water.
    d) write to agencies for materials related to water and the environment for use in the school library.
    e) develop a television commercial.
    f) conduct an opinion poll, interview people about water and the environment and report the results.
    g) write a skit or play about a water problem in the county.
    h) write informative articles about water and the environment for the school or local newspaper.
    i) hold a photography contest about water.

Word Review Game

There are many ways to present the information for review. Competitive games keep interest up. The following is a game that has worked for time periods from 10 minutes to a full class period.

Divide the class into two teams. The teacher is the leader score keeper, and referee. The teacher thinks of an environmental word and puts the number of blanks corresponding to the letters of the word on the board.

The first person of Team I guesses a letter. If it is in the word, the letter is put in the appropriate blank. If it isn't in the word, then Team I gets one of three (allowed) strikes against it. Team II member guesses another letter with the same consequences for his team.

This procedure is continued until either team is ready to guess the word and give its definition. If the team defines the word correctly, they get one point. If the team member misses the word or its definition, then the other team gets a chance at the word and its definition and if correct they gain one point.

One point is gained by a team when

1) the other team "strikes-out" (Makes 3 wrong guesses on one word).
2) they give a correct definition.
3) the other team is discourteous and blurts out answers or interrupts.

Modifications of this game can be used. Also a form of Hollywood Squares can be used to review environmental knowledge.

Suggested Review and Reading Exercises

Exercise I

Case of the missing man-hole cover.

Before the students read the case, have them match these terms with a related definition:

_____	infiltration	A) organisms that break down organic wastes
_____	sewerage	B) slows down or retards
_____	inhibits	C) washing and/or wearing away of top soil
_____	bacteria	D) extra heavy amounts of water and/or mud reach the waste water treatment plant
_____	erosion	E) network of sewer pipes to carry sewage to the treatment plant

The Crooked Creek Waste Water Treatment Plant has trouble, called infiltration, after a heavy rain. The rain water flows through the sewerage system and dilutes the organic wastes and the bacteria concentrations that break down the waste.

An official at the Water Pollution Control Department related this story: "When we have heavy rains, we get a big slug of mud down through the plant. Mud fills up the plant and it inhibits bacterial action. It [the mud] not only inhibits action but it settles out in the equipment. . . . We later found three man-hole covers missing [in an area of Peachtree Corners that is under construction].

I don't know what they do with them, but every now and then somebody will steal our man-hole covers. For what purpose I have no idea. They weigh about 50 pounds. They [the department crew] put new covers on. During the last rain we had, there was very little noticeable mud in our plant."

_____ The sentence "Mud inhibits bacterial action" means:
- a) mud slows down the natural processes of cleaning up waste water.
- b) mud speeds up the bacterial action by adding nutrients to the water.
- c) mud settles over the equipment
- d) all of the above.

_____ Most probably that 'glob of mud was caused by
- a) a crushed sewer pipe
- b) rain water washing through a big parking lot
- c) mean kids throwing dirt into the sewer
- d) soil erosion at a construction site

Reading Exercise I

Read this paragraph quoted from a county official at the Water Pollution Control Department and answer the questions that follow.

> "Some detergents and concentrations will kill all our friendly little animals in our sewage plant. The sewage system is the largest zoo in the world. We have more animals in our sewage system than in all the zoos put together. It's our little bacteria that activate the sludge. There are all kinds of bacteria. They live on sewage and we work them 24 hours a day."

___ What is meant by the statement "The sewage system is the largest zoo in the world?"

a) Micro-organisms are fun to watch.
b) Catfish are raised in sewage treatment plants.
c) Zoos like Grant Park in Atlanta are polluted
d) A tremendous number and variety of bacteria live on sewage.

___ The most important role of bacteria in the sewage system or 'zoo' is that they

a) biologically breakdown larger organic compounds into recyclable elements.
b) hold down the algae and fish populations in sewage treatment plants.
c) furnish needed oxygen for sewage recycling.
d) furnish needed CO_2 for sewage recycling.

___ The important anaerobic bacteria that are necessary for complete sewage breakdown are found

a) living with the algae
b) on rocks
c) in sludge
d) living in the soil outside the sewage system

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Key To Text Questions

Page 5

I		II	
	B		B
	A		A
	C		C
	E		B
	D		D

Page 21

B
C
C
A

Page 31

1) A
2) A
3) A
4) A

Page 33

1) A
2) A
3) A
4) A
5) A
6) A
7) A

Page 54

1) A
2) B

Review

1) B
2) A
3) D
4) B
5) C
6) A
7) C
8) D
9) B
10) D
11) C

SUPPLEMENTAL MATERIAL

Student Evaluation of the Module

1. a) Which lesson was the most interesting to you?
   b) Why?

2. a) Which lesson was the least interesting?
   b) Explain why.

3. What topic did you learn the most about?

4. a) How would you improve the booklet?
   b) The activities?

Information Sources

Bill Atkinson, Chairman
Board of County Commissioners
Lawrenceville, Georgia 963-0271

John Bryson, County Extension Agent
Lawrenceville Square
Lawrenceville, Georgia 963-0271

Jay Bartlett
Jackson Creek Waste Water Treatment Plant
Lilburn, Georgia 921-7570

Emmett Clower, Mayor
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Snellville, Georgia

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Don Holt, News Staff Writer
Gwinnett Daily News
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HOW MUCH WATER IS WASTED?

Class Activity

Sewage consists of approximately 99.98 percent water, 0.02 to 0.03 percent suspended solids, and other dissolved soluable organic and inorganic substances. On a percentage basis, the amount of solids appears small. Use the following information and see how small that amount is.

About 28 small plants each handle less than 1 million gallons a day. The newest plants at Crooked Creek in 1972 and at Jackson Creek in 1975 each can process more than 1,000,000 gallons of waste water a day.

one gallon = approximately 10 pounds

one ton = 2,000 pounds

.02 × 1,000,000 = _____?_____

_____?_____ ÷ 10 = _____?_____?_____

How many tons of solid waste is produced at Crooked Creek each day?

a) 1 ton
b) 2 tons
c) 4 tons
d) 10 tons

How many gallons of water had to be used (or wasted) to carry away that amount of solid waste matter each day?

a) 1,000,000 gallons
b) 100,000 gallons
c) 2,000,000 gallons
d) 10,000 gallons

Remember how few people in the county can use these treatment plants!